

In the United States Patent and Trademark Office

Serial Number: 09/722,878
Application Filed: 11/27/2000
Applicant(s): Eric Christian Hince
Application Title: Solid-Chemical Composition for the Non-
Exothermic Chemical Oxidation and Aerobic
Bioremediation of Environmental Contaminants
Examiner: Margaret B. Medley
Group Art Unit: 1714

Via Facsimile: 24 September 2003

At: Florida, New York

DECLARATION UNDER 37 C.F.R. §1.132

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

I, Eric C. Hince, residing at 25 Day Road, Campbell Hall, NY 10916, hereby declare the following.

1. I am the inventor of the above-identified patent application.
2. I graduated from the State University of New York at Stony Brook in 1986 with a B.S. degree in Geology, and in 1991 with a M.S. degree in Marine Environmental Sciences. I conducted further Ph.D. level graduate studies in Oceanography at Old Dominion University in 1988 and in Environmental Health Sciences at New York University from 1991 to 1992. I have been employed as a professional scientist in the field of environmental site-investigation and remediation from 1988 to date. As founder,

President and Chief Technology Officer of Geovation Consultants, Inc. and Geovation Technologies, Inc. from 1991 to date, I have been involved in the research, development, manufacture and application of chemical compositions and methods for in-situ bioremediation. From on or about 1998 to date, I have been extensively involved in the research, development, manufacture and application of solid-chemical compositions (and related methods of use) that have utility for the in-situ bioremediation of environmental contaminants in geologic media. I am the named sole, principal or co-inventor on several patents issued by the U.S. PTO for liquid- and solid-chemical compositions and methods for the in-situ bioremediation of environmental contaminants in geologic media. I am considered to be an expert in the field of environmental site investigation and remediation science and technology, and I have been admitted as an expert witness in both State and Federal Courts for testimony related to my areas of expertise. The patented and patent-pending bioremediation technologies (i.e., compositions and their methods of use) that I have invented have had a measurable amount of commercial success to date as evidenced by the revenues from products and services sold by Geovation Consultants, Inc. and Geovation Technologies, Inc. (combined) which have exceeded \$1.2 M to \$1.7 M per year on average for the last three years, supporting the employment of 15 persons (including both full- and part-time personnel).

3. The references to Gago 4,470,839, Felix et al 5,725,885, and Gaffar et al 5,648,064, as cited by the Examiner, were unknown to me at the time when I developed the present invention and when the instant patent application was filed. These references first came to my attention in the Examiner's office action dated 4 October 2002 (Paper No. 6).
4. Subsequent to the Examiner's most recent office action dated 24 April 2003, a telephone conference was held on 22 July 2003 between the Applicant and the Examiner to specifically discuss the Examiner's prior 35 U.S.C. 102(b) rejection of the instant claims, with specific attention to the language of Claim 1. Subsequently, the

Applicant received a written Interview Summary of the 22 July 2003 telephone conference from the Examiner that was mailed on 30 July 2003. In the Applicant's Amendment C filed contemporaneous with this declaration, the Applicant amended Claim 1 in accordance with the examiner's suggestions during the 22 July 2003 conference with the Examiner and provided in the Examiner's 30 July 2003 summary thereof in order to advance prosecution of the application.

5. In the Examiner's office action dated 24 April 2003, the Examiner maintained the 103(a) rejections as below:

"Claims 1-4, 7-8, 13-14, 17-18 and 37-38 for reasons made of record in Paper No. 6 dated October 4, 2002 and for reasons set forth above remain rejected under 35 U.S.C. 103(a) as being unpatentable over Gago 4,470,839...

...Claims 5, 11-12 and 15-16 for reasons made of record in Paper No. 6 dated October 4, 2002 and for reasons set forth supra remain rejected under 35 U.S.C. 103(a) as being unpatentable over Gago 4,470,839 as applied to claims 1-4, 7-8, 13-14, 17-18 and 37-38 above, and further in view of Felix et al (Felix) 5,725,885...

...Claims 6, 9-10 and 21-34 for reasons made of record in Paper No. 6 dated October 4, 2002 and for reasons set forth supra remain rejected under 35 U.S.C. 103(a) as being unpatentable over Gago 4,470,839 in view of Felix et al (Felix) 5,725,885 as applied to claims 1-5, 7-8, 11-18 and 37-38 above, and further in view of Frisey 3,796,637 and Gaffer et al (Gaffer) 5,648,064...

...Applicant's arguments filed February 4, 2003 have been fully considered but they are not persuasive...

...Applicants have not produced evidence of record to the contrary that the dry coated particles of Gago are not the particles produced by the drying mixing of the two components of the instant claims...

... It is the examiner's position that the prior art composition is identical to that set forth in the instant claims, and would release the phosphate coating along with the oxygen release...

...Furthermore, MPEP 2111.02 states that statements in the preamble reciting the purpose or intended use of the claimed invention must be evaluated to determine whether the purpose or intended use results in a structural difference between the claimed invention and the prior art. Only if such structural difference exists, does the recitation serve to limit the claim. If the prior art structure is capable of performing the intended use, then it meets the claim...

...It is the examiner's position that the composition of the instant claims and therefore would produce the same 1, 2 and 3 advantages advanced by applicant in the bridging paragraph of pages 13 and 14 of Paper No. 8 dated February 4, 2003..."

The Applicant believes that the composition of Claim 1 of the present invention, as rewritten in the Applicant's Amendment C dated 24 September 2003, is (i) different than and patentably distinct from that of Gago, and (ii) non-obvious from the reference to Gago and the other references cited by the Examiner on the basis of the unexpected properties and advantages thereof of the present invention (among other factors). Accordingly, this declaration is intended in part to describe the Applicant's experiments to make clear the patentable distinctions and non-obvious advantages of the present invention over Gago.

6. Initial Experiments and Unexpected Results. The inventor conducted a number of experiments, the observations and unexpected results of which led to the development of the present invention.

The inventor's research and development efforts concerning the present invention began with the formulation, manufacture and preliminary testing of two early-stage prototype compositions: i.e., the "1" and "2" series compositions. This work was

followed shortly thereafter by the formulation, manufacture and preliminary testing of a third, mid-stage prototype composition, the "3" series composition. Based on the observations of the initial lab-scale jar testing of the "1", "2" and "3" series compositions, and the preliminary field testing of the "1" series composition, the "4" and "5" series compositions were formulated, manufactured and tested by the inventor.

The formulations of the "1", "2", "3", "4" and "5" series compositions and the empirical observations of their manufacturing characteristics and initial experimental trials are summarized in Table 1 (attached). The active-oxygen ingredient used to prepare each composition was the same: a food-grade calcium peroxide powder (75% CaO_2 by weight) manufactured by FMC Corporation. Similarly, the same commercial sources and grades of the remaining ingredients used in the compositions were generally consistent. Each of these compositions was prepared in the form of granules by dry mixing discrete particles of the ingredients (in the proportions shown in Table 1) in a stainless-steel ribbon blender followed by direct compaction in a commercially available roll compactor. A Fitzpatrick Model IR-520 roll compactor, including a Model M5A granulator, was used to prepare granules of each of the compositions. (The Model IR 520 Fitzpatrick Chilsonator system is a small-scale version of larger Fitzpatrick Company's briquetting and granulation roll-compaction systems, and is typically used for small-scale production runs and prototype tests, the results of which can be scaled to larger Fitzpatrick Chilsonator systems). As summarized in Table 1, the relative ease of roll compaction and relative quality of the granules produced varied widely among these compositions. The "1" and "2" series compositions exhibited significant problems with the material sticking to the stainless steel feed screws and rolls of the IR-520. Sticking problems were most severe with the "2" series composition, which resulted in a very-low production rate and a poor quality granulation. Despite changing the IR-520 rolls to evaluate whether different roll-face configurations could improve production results, only a small amount of a poor quality granulation of the "2" series composition was produced which limited the testing of this composition to small-scale jar tests as described in Example 1 of the specification. Slightly better granulation results were obtained with the "1" series compositions, such that greater quantities of

fair-quality granules were produced for the "EZ-Ox 1.2" and "EZ-Ox 1.3" variants of the "1" series composition which provided sufficient material for both lab-scale and limited field-scale testing. Roll-compaction characteristics and granulation qualities improved markedly with the "3" series composition, which was interpreted to be attributable to the introduction of a small amount of magnesium stearate (0.5% by weight) as a lubricant to help prevent sticking of the composition to IR-520 feed system and rolls. The best roll-compaction production characteristics, rates and granulation qualities were obtained for the "4" series and "5" series compositions (Table 1). As described in the specification, the oxygen-release characteristics of the "4" and "5" series compositions, which were shown to maintain their granular form for extended periods of time, were also dramatically improved relative to the earlier compositions. The unexpected oxygen-release properties of the "4" and "5" series compositions solved a long-felt problem and need with respect to granular forms of calcium peroxide compositions produced by roll compaction (see below), prompting the inventor to file the instant patent application.

Noteworthy is that unlike the compositions of the Gago reference cited by the Examiner, which included only one "condensed phosphate" in preparation of the "coating agent" used to prepare the "coated particles", the top-performing trial of the inventor's initial composition formulations, i.e., the "1" series composition, contained two different complex inorganic phosphates: sodium hexametaphosphate and sodium trimetaphosphate. Also noteworthy is that the "3" series composition included only one complex phosphate: sodium hexametaphosphate. Although unknown to the inventor at the time of the invention, given that the "3" series composition contained only one complex phosphate, the inventor's "3" series composition was that which was most similar to the teachings of Gago (a) on the basis of the prior language of the instant claim 1, (prior to its amendment by the Applicant on 24 September 2003), and (b) as per the prior written opinions maintained by the Examiner in the office action dated 24 April 2003. However, based on the comparative and unexpected results of the empirical testing of the aforementioned "1", "2" and "3" series compositions (see below),

and despite the aforementioned improvement achieved with the "3" series composition with respect to its roll-compaction manufacturing characteristics, the inventor abandoned the "3" series composition and developed the "4" and "5" series compositions described in Example 3. The inventor's formulation of the "4" and "5" series compositions was based on the extrapolation of the observed advantages of the use of multiple complex phosphates in the aforementioned "1" series composition, which was not known or obvious to the inventor prior to experimentation. Noteworthy is that both the "4" and "5" series compositions contained three different complex inorganic phosphates: sodium hexametaphosphate, sodium trimetaphosphate and sodium tripolyphosphate (Table 1).

The initial jar testing of the granular "3" series composition was conducted shortly after the initial tests of the "1" and "2" series compositions described in Example 1 in the specification. Observations of the "3" series composition were similar to those of the "2" series composition—i.e., unwanted platy aggregates or "scales" of mineral precipitates were observed to form on the granules in water-column tests conducted under similar conditions to those described in the specification for the "1" and "2" series compositions. The formation of such mineral precipitates as observed in water-column tests of the "2" and "3" series compositions was considered to be highly undesirable, as prior "industry" knowledge obtained from personal communications between the inventor and scientists in the active-oxygen division of the supplier of the calcium-peroxide material used in the compositions described in Table 1, FMC Corporation, indicated that such mineral precipitates and coatings, such as calcium sulfate, were known to form on granules of calcium peroxide produced by roll compaction. The results of prior testing conducted by the FMC scientists, as communicated to the inventor during the summer of 2000, had shown that the formation of such mineral precipitates and coatings on the calcium peroxide granules caused a "lock-up" effect whereby a potentially significant amount of the active-oxygen content of the calcium peroxide became trapped inside the granules and was not effectively released (as desired). Accordingly, a specific objective of the inventor's formulation, manufacture and initial testing of the inventor's compositions was to produce granular compositions

that readily released the oxygen content of their active-oxygen ingredient (FMC food grade calcium peroxide as used in the inventor's trials). Hence, for clarification, the inventor's observation of the formation of such mineral precipitates in the initial jar-testing of the prototype compositions was used as a diagnostic "negative" indicator, such that further manufacture or testing of such compositions (i.e., the "2" and "3" series compositions) was not conducted. Moreover, the inventor used the unexpected results from these "trial and error" experiments to develop the highly successful "4" and "5" compositions. The "4" and "5" compositions form the basis of not only the instant claims of the present invention, but also the current "EZ-Ox" product that is currently manufactured, sold to customers and deployed at contaminated sites on a successful commercial scale. In fact, the current, commercially successful "EZ-Ox" product is nearly identical in composition to the "5" series composition described in the specification and herein (Table 1).

7. Long-Felt Need for the Present Invention as an Improved Means for Active Oxygen and Commercial Success of The Present Invention as Demonstrated by Field Applications.

As described in paragraph 6 above, a specific objective of the inventor's formulation, manufacture and initial testing of the inventor's compositions was to produce granular compositions that readily released the oxygen content of their active-oxygen ingredient, e.g., food grade calcium peroxide. During the inventor's participation in two major environmental-remediation industry and technology trade shows in May and June of 2000, the long-felt need for an improved active-oxygen product for aerobic bioremediation came to the inventor's attention. In particular, a number of different environmental professionals, including both scientists and engineers, related to the inventor a number of problems they encountered with the most widely used and commercially available active-oxygen product, the "Oxygen Release Compound" or "ORC" produced by Regenesis. Regenesis' "ORC" product that was commercially available at the time the inventor developed the present invention, and which is still used in commerce, is a food-grade material comprising a powdered form of magnesium-peroxide intercalated with simple phosphates (Koenigsberg, et al

5,264,018). The problems with Regenesi's "ORC" product as related to the inventor at these trade shows included difficulties with the handling and subsurface application of the powdered "ORC" product, nuisance worker inhalation and mucous-membrane exposures to the irritant dusts (attributable to both its nature as a strong oxidizer and the tendency for the powdered product to produce airborne dusts when handled), as well as complaints about the relatively low active-oxygen content in comparison to commercially available calcium peroxide ("ORC" is represented to contain 10% active-oxygen by weight). In addition, a specific problem with Regenesi's "ORC" filter sock products was related to the inventor. A number of environmental professionals described the tendency of the "ORC" socks to swell and "set up" like concrete when installed in ground-water wells, such that the socks would become stuck in the wells and rip apart when persons would try to remove the "stuck" socks, such that the concrete-like "ORC" material would fall out of the torn socks and become lodged in the wells. It has since come to the inventor's attention that this has been a widespread problem that has been commonly experienced by environmental professionals using Regenesi's "ORC" socks.

Based on the foregoing, the inventor recognized that there was a long-felt need for the development of an improved active-oxygen composition that could overcome the aforementioned disadvantages and limitations of the "ORC" product and the commercially available calcium-peroxide powders. Beginning in late June 2000, the inventor worked to develop an improved solid-chemical composition that could overcome these shortcomings. To overcome the aforementioned problems associated with the handling, application and swelling of the powdered "ORC" and commercially available calcium- and magnesium-peroxide powders, the inventor focused on the production of granular and briquetted forms of active-oxygen containing compositions by roll-compaction. To overcome the active-oxygen content limitations of "ORC" and commercially available magnesium peroxide powders, the inventor focused on the use of a food-grade calcium peroxide powder (75% CaO_2 by weight) manufactured by FMC Corporation as the active-oxygen source. As described in paragraph 6 above, during the inventor's consultations with scientists in the active-oxygen division of FMC

Corporation, and others, it came to the inventor's attention that the potential advantages and need for a granular form of calcium peroxide were long-felt needs recognized by the FMC scientists. However, the FMC scientists indicated that mineral precipitates and coatings, such as calcium sulfate, tended to form on granules of calcium peroxide produced by roll compaction, which caused a "lock-up" effect whereby a potentially significant amount of the active-oxygen content of the calcium peroxide became trapped inside the granules and was effectively "lost" and not effectively released (as desired).

Hence, an immediate objective of the inventor was to overcome these known limitations of the prior art and to address this long-felt commercial need by inventing compositions that could be easily produced in granular forms by roll compaction and that readily released their active-oxygen content for prolonged periods of time. However, during the initial stages of the inventor's research and development of the present invention, I became aware from my discussions with FMC scientists that while it had been recognized that a granular form of calcium peroxide may be desirable for certain applications, prior testing had demonstrated inherent oxygen "lock-up" problems with such granular forms of calcium peroxide. According to discussions with the FMC scientists and others at that time, it was presumed that the much lower surface-area-to-volume ratio of the granular forms of calcium peroxide produced by roll-compaction, in comparison to the much higher surface-area-to-volume ratio of powdered calcium peroxide, made the aforementioned mineral precipitate formation and oxygen "lock up" effect more pronounced for the granules than for the powders. Accordingly, while the FMC scientists acknowledged that the granular forms of calcium peroxide could, theoretically, provide greatly improved material handling characteristics for a number of applications or utilities, the higher surface-area-to-volume ratio of the powdered forms of calcium peroxide provided more effective and complete oxygen release that was essential for their customers' main industrial applications, such as dough-conditioning and consumer products.

From these discussions, the inventor also became aware that in the early 1990s, FMC had previously manufactured and sold a technical-grade calcium peroxide product for the environmental-remediation industry marketed under the trade name "Permeox." It was also learned from FMC and others that the oxygen lock-up effect was observed for the "Permeox" product, as was also commonly encountered with other powdered calcium peroxide products, such that the effective period of oxygen release of "Permeox" was generally limited to about 30-60 days, depending on environmental conditions. The FMC scientists further explained that FMC ultimately abandoned the manufacture and sale of the technical-grade "Permeox" product based on what they perceived to be an environmental market that was too small and fragmented to be worthwhile as a business enterprise to FMC. Hence, the FMC scientists explained that the production and sale of the technical-grade "Permeox" product was abandoned in favor of a streamlined product offering whereby FMC only produced the food-grade calcium peroxide product.

Noteworthy is that Gago's invention was assigned to the world's second-largest manufacturer of active-oxygen chemicals, Interlox (now known as Solvay Interlox). The apparent lack of commercial success of the invention of Gago, as evidenced by the lack of a commercially available or widely-recognized product or technology (based on the Gago reference) in the field of the present invention, among others, further indicates that the long-felt need for overcoming the aforementioned problems and limitations of the prior art of granular active-oxygen compositions had not been met.

Based on the summary of the inventor's discussions with the FMC scientists provided above, there was clearly an expectation on the part of these scientists that granular calcium peroxide compositions would meet with the same difficulties that they had encountered (as described above). Accordingly, the inventor's aforementioned experiments, which yielded surprising and unexpected results, satisfied the long-felt need in the industry as the inventor's granular compositions, in accordance with the present invention, did not suffer the limitations and disadvantages of the prior art.

In view of the foregoing, it should be clear that at the time of the inventor's development of the present invention there was still a recognized and long-felt need for

overcoming the aforementioned problems and limitations of the prior art active-oxygen compositions that had not been solved, even by scientists at FMC Corporation, the largest manufacturer of active-oxygen chemicals in the world, and Solvay-Interox, the second-largest manufacturer of active-oxygen chemicals in the world. In conclusion, given the stated advantages of the present invention, it should be evident that the instant invention meets the long-felt need for overcoming the disadvantages and limitations of the prior art that had not previously been accomplished, even by scientists at the world's two largest manufacturers of active-oxygen chemicals, who undoubtedly had the backing of significantly greater technical and financial resources than the inventor and the assignee of the present invention. These accomplishments demonstrate clearly and conclusively the patentable distinctions and non-obvious advantages of the present invention over the prior art, including Gago's invention and the other prior-art references cited by the Examiner.

8. Commercial Success of The Present Invention. In view of the advantages and long-felt need of the present invention, and despite the limited financial resources and lack of well-established sales and marketing channels of the inventor's assignee in comparison to its competitors, the inventor's assignee has (since the time of the invention) begun to recognize growing commercial success in terms of market awareness, acceptance and use of the present invention for subsurface environmental-remediation applications. This commercial success has been realized despite the economic recession and the overall decline and contraction of the environmental-remediation industry. Over the last year, and even the last several months, the inventor's assignee has seen increased orders of their "EZ-Ox" products that are based on the present invention. The assignee has also received reports of observations from a customer and scientist employed by one of the largest environmental firms in the world, to the effect that "they" (the scientist and colleagues in his firm) were very impressed with the oxygen-release characteristics of the "EZ-Ox" product relative to their past experience with other commercially available products. Their success lead to their decision to place an additional EZ-Ox product order for their ground-water remediation project.

This customer represented that they were consistently achieving super-saturated dissolved oxygen (DO) levels (>20 mg/L) in the ground-water within the "EZ-Ox" treatment zone, and that they observed 3-8 mg/L increases in DO in ground-water monitoring wells on the order of 60 feet downgradient of the "EZ-Ox" treatment zone(s). Given that the practical limit of DO solubility in most ground-water aquifers is typically on the order of only 6-8 mg/L, the observed increases in DO were viewed to be quite substantial, and based on the recent personal communications between the assignee's employees and the customer, it is fair to say that this customer and his colleagues at this consulting firm were genuinely surprised by the oxygen-release characteristics of the assignee's "EZ-Ox" product. This customer also represented that based on these results, he and his colleagues at his consulting firm were seriously considering the purchase and deployment of the assignee's product on a larger scale and at other sites.

I, the undersigned declarant, declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 24th day of September 2003



Eric C. Hince

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Table 1

Composition Series / Specification Reference		"1"	"1"	"1"	"2"	"3"	"4"	"5"
Inventor Composition Name / ID		EZ-Ox 1.2	EZ-Ox 1.3	EZ-Ox 2.1	EZ-Ox 3.1.2	EZ-Ox 4.1	EZ-Ox 5.1	
Composition Ingredients / Description		Weight %	Weight %	Weight %	Weight %	Weight %	Weight %	Weight %
ACTIVE OXYGEN SOURCE								
FMC Food-Grade Calcium Peroxide (75%)		92.50%	93.75%	92.50%	94.50%	94.25%	94.25%	
COMPLEX INORGANIC PHOSPHATES								
Sodium Tripolyphosphate		0.00%	0.00%	0.00%	0.00%	0.50%	0.50%	
Sodium Trimetaphosphate		1.00%	1.00%	0.00%	0.00%	1.00%	1.25%	
Sodium Hexametaphosphate		1.50%	1.50%	0.00%	3.00%	2.75%	3.50%	
ORGANIC DISINTEGRANTS								
Starch 1500/Industrial Pre-Gelled Starch		4.00%	3.50%	5.00%	2.00%	1.00%	0.00%	
Sodium Starch Glycolate		0.50%	0.00%	1.50%	0.00%	0.00%	0.00%	
Spray-Dried Molasses Powder		0.50%	0.25%	1.00%	0.00%	0.00%	0.00%	
LUBRICANTS								
Magnesium Stearate		0.00%	0.00%	0.00%	0.50%	0.50%	0.50%	
Roll Compaction / Granulation Production Observations								
Poor: Major sticking, Low-Quality Granulation				X				
Fair: Some sticking, Fair-Quality Granulation		X	X					
Good: Little sticking, Good-Quality Granulation					X			
Excellent: No sticking, Excellent-Quality Granulation						X	X	
Initial Jar Test Observations								
Poor: Significant scale/precipitate formation, O ₂ Lock-up				X				
Fair: Some scale/precipitate formation, O ₂ Lock-up			NA		X			
Good: No scale/precipitate formation or O ₂ Lock-up		X				X	X	
Initial Ground-Water Field-Trial Observations								
Fair: Moderate O ₂ Levels, Release Profile		X	X	NA	NA			
Good-Excellent: High O ₂ Levels, Extended Release Profile						X	X	

NA = Not Available - Testing Not Conducted / Data Not Available

Declaration Under 37 C.F.R. §1.132; Ser. No. 09/722,878